

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

UNDERGROUND OUTLET

(Feet)

CODE 620

DEFINITION

A conduit installed beneath the surface of the ground to collect surface water and convey it to a suitable outlet.

PURPOSE

Dispose of excess water from terraces, diversions, subsurface drains, surface drains, trickle tubes or principal spillways from dams (outside the dam area only), or other concentrations without causing damage by erosion or flooding.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where: (1) excess surface water needs to be disposed of; (2) a buried outlet is needed for Diversions (362), Terraces (600), or similar practices; (3) an underground outlet can be installed that will safely dispose of excess water; and (4) surface outlets are impractical because of stability problems, climatic conditions, land use, or equipment traffic.

CRITERIA

Federal, State and Local

Design and construction activities shall comply with all federal, state, and local laws, rules, and regulations governing activities in or along streams, pollution abatement, health, and safety.

The owner or operator shall be responsible for securing all required permits or approvals and for performing all planned

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work in accordance with such laws and regulations. NRCS employees are not to assume responsibility for procuring these permits, rights, or approvals, or for enforcing laws and regulations. NRCS may provide the landowner or operator with technical information needed to obtain the required rights or approvals to construct, operate, and maintain the practice.

Permits may be required from the following agencies when obstruction removal is performed within the boundaries of a stream or floodplain or if burning is required:

- 1. U.S. Army Corps of Engineers***
- 2. WV Department of Natural Resources***
- 3. WV Public Lands Corporation***
- 4. US Fish and Wildlife Service***
- 5. Local state and county ordinances***

Work near waters where there is a present or possible presence of endangered or threatened species require notification and collaboration with the USFWS prior to implementation.

Work in or adjacent to "Waters of the US" may require a WV Public Land Corporation Application, a Nation Wide Permit or appropriate Individual Section 404 permit from the USCOE prior to implementation of the project. All required permits shall be approved prior to construction implementation.

Capacity. The underground outlet shall be designed, alone or in combination with other

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practices, with adequate capacity to insure that the terrace, diversion, or other practices function according to the standard for the specific practice. For example, an underground outlet can be used in combination with a grassed waterway or a surface drain to carry part of the design flow. The capacity of the underground outlet for natural or constructed basins shall be adequate for the intended purpose without causing excessive damage to crops, vegetation, or improvements.

Procedures contained in the Engineering Field Manual for Conservation Practices, Chapter 3 and the national Engineering Handbook, Section 5, Hydraulics will be used as appropriate.

Inlet. An inlet can be a collection box, a perforated riser, or other appropriate device. Its capacity shall be adequate to provide the maximum design flow in the conduit. Flow-control devices shall be installed as necessary. Perforated risers must be of durable material, structurally sound, and resistant to damage by rodents or other animals. If burning of vegetation is likely to create a fire hazard, the inlet shall be fire resistant. Blind inlets can be used where they are effective ***and meet WV Conservation Practice Standard (CPS) 606-Sub-surface Drain.*** Collection boxes must be large enough to facilitate maintenance and cleaning operations. The inlet must have an appropriate trash guard to insure that trash or other debris entering the inlet passes through the conduit without plugging. It must also have an animal guard to prevent the entry of rodents or other animals.

Inlets will be designed with sufficient anchorage to prevent floatation, with a minimum factor of safety of 1.5. Concrete inlets, five (5) feet or less in height, shall have a minimum wall thickness of six (6) inches and be reinforced with one layer of welded wire fabric (6" x 6" – 8 gauge by 8 gauge minimum). All other concrete inlets will be designed according to the procedures obtained in NEW-6, Structural Design.

When more than one inlet is used, the upper inlets will be designed to control the flow so discharge will not occur through the lower inlets.

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Pressure-relief wells shall be designed and installed as needed to control pressure. If junction boxes and other structures are needed, they shall be designed and installed in a manner that facilitates cleaning and other maintenance activities.

Hydraulics. Underground outlets shall be continuous conduits, tubing, or tile. Joints shall be hydraulically smooth, and the materials and methods used shall be recommended by the manufacturer. If a pressure system is used, joints shall be adequate to withstand the design pressure, including surges and vacuum. The maximum velocity must not exceed the safe velocity for the conduit materials and installation.

Lines shall be adequate to carry the design flow when the outlet and all inlets are operating at design capacity. Positive grade shall be maintained in all sections of an underground outlet. Capacity shall be based on the pipe size or on other flow control devices to prevent water from the upper inlets from discharging through the lower inlets. The minimum conduit diameter shall be 3 inches. ***Conduits will be designed with a minimum velocity of 0.5 ft per second when there is no hazard of siltation and with a minimum velocity of 1.4 ft per second if siltation is a problem. If site conditions are such that the minimum velocity cannot be met, then provisions shall be made for preventing sedimentation by use of filters or by collecting and periodically removing sediment from installed traps. Planned cleaning of lines with high pressure jetting systems may also be considered.***

All systems will be designed to protect the pipe from excessive vacuum and surge pressures at elbows and other fittings when:

1. ***The pipe grade increases in the direction of flow by 10% or more or***
2. ***The pipe grade decreases in the direction of flow by 5% or more or***
3. ***The velocity in the pipe exceeds 15 feet per second.***

This protection may be provided by:

1. ***Designing pipe and joints to withstand the pressures, or***

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2. ***Installing vents or vacuum release valves where pipe grade increases, or***
3. ***Installing pressure relief wells, pressure relief valves or surge tanks where pipe grade decreases.***

Vents, wells or other structures installed to provide protection from vacuum or surge will be designed according to requirements in CPS 430 (AA-EE) Irrigation Water Conveyance.

Materials. Materials shall meet or exceed the design requirements against leakage and shall withstand internal pressure or vacuum and external loading. ***Thrust protection will be provided at elbows, bends and other fittings as necessary.*** Plastic, concrete, aluminum, and steel shall meet the requirements specified in the applicable ASTM standard. All materials specified for Subsurface Drains (606) can be used for underground outlets. Conduits, however, can be perforated or nonperforated, depending on the design requirements. A filter fabric wrap (sock) or equivalent shall be used if migration of soil particles around conduit is anticipated.

Pipe which is not pressure rated for water, such as corrugated polyethylene drainage tubing, will only be used when inlet controls, such as orifice plates, are used to restrict flow to that capacity at which the pipe begins to flow full; determined by Manning's equation.

When inlet control is not provided and pressure flows occurs, pipe with pressure ratings equal to or higher than the design pressures shall be used.

All exposed plastic materials shall be protected from degradation due to exposure to sunlight.

Outlet. The outlet shall be sufficiently stable for all anticipated flow conditions ***and provide for release of flow at non-erosive velocities as follows. Cantilever outlet sections, if used, shall be designed to withstand the cantilever load, and pipe supports shall be provided when needed. Pipe supports shall be installed on all pipes where:***

1. ***The exit velocity is 10 feet per second or greater.***

2. ***The length of the cantilever portion, measured along the pipe invert, is more than 35% of the total length of the last joint of pipe for pipe diameters 15 inches or less.***
3. ***The length of cantilever portion is more than 20% of the total length of the last joint for pipe diameters greater than 15 inches.***

Energy dissipating outlet structures such as an impact basin, SAF outlet or those meeting the requirements of procedures contained in the EFM, Chapter 7, Design Note 6 will be installed for all pipe outlets, unless the outlet is on rock, into a permanent deep pool of water or other location where erosion will not be a problem.

It shall be designed for the maximum anticipated water surface at design flow. ***The invert elevation of all conduit outlets shall be a minimum of 1.0 foot above the outlet channel.***

A continuous section of closed conduit or a headwall can be used at the outlet. If a closed conduit is used, it shall be durable and strong enough to withstand all anticipated loads, including those caused by ice. Outlets shall not be placed in areas of active erosion. If fire is a hazard, the outlet shall be fire resistant. All outlets must have animal guards to prevent the entry of rodents or other animals. Animal guards must be hinged to allow passage of debris.

Protection. All disturbed areas shall be reshaped and regraded so that they blend with the surrounding land features and conditions. Visual resources must be given the same consideration as other design features. Areas that are not to be farmed or covered by structural works shall be established to vegetation, ***according to CPS 342 Critical Area Planting*** or otherwise protected from erosion as soon as practicable after construction.

CONSIDERATIONS

Consider effects on the water budget, especially on volumes and rates of runoff,

infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

Consider effects on the volume of downstream flow that might cause undesirable environmental, social, or economic effects.

Evaluate potential use for water management.

Consider effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that would be carried by runoff.

Consider effects on the visual quality of downstream water resources.

Consider the construction-related effects on the quality of downstream watercourses.

Consider effects on wetlands or water-related wildlife habitats.

Evaluate potential impact on water quality due to agri-chemicals in outflow.

Consider depth of underground outlet in regard to tillage equipment depth and maintenance, if applicable.

Fencing may be necessary to exclude livestock or humans for safety or protection of the outlet and shall be constructed according to WV CPS 472 Livestock Exclusion or 382 Fencing.

PLANS AND SPECIFICATIONS

Plans and specifications for installing underground outlets shall be in keeping with this standard and shall describe the requirements for installing the practice to achieve its intended purpose.

Construction and material specifications will be prepared in conformance with NEH-20 or WV "700" series specifications, or the attached specification with the following guidelines:

- 1. The applicable specification for pipe will be shown on the drawings.***
- 2. If riprap and/or drainfill is used, the quality, size and gradation will be shown on the drawings.***
- 3. Application rates for seeding and mulching materials will be shown on the drawings.***

- 4. Details and dimensions of inlet and outlet structures, a thrust blocks, vents, relief wells, riprap slope protection, safety measures and fences shall be shown on the drawings.***

Operation and Maintenance

Underground outlets shall be maintained by:

- Annual inspections and inspections after each major storm occurrence to assess the need for repair.***
- Keeping inlets, trash guards, and collection boxes and structures clean and free of materials that can reduce the flow
- Repairing leaks and broken or crushed lines to insure proper functioning of the conduit
- Checking outlet conduit and animal guards to ensure proper functioning of the conduit
- Keeping adequate backfill over the conduit
- Repairing any eroded areas at the pipe outlet such as vegetation or riprap or other.
- Liming, fertilizing, reseeding (if necessary) and mowing of vegetation to maintain a healthy growth.***